

We claim:

1. An angle measuring gyroscope which measures a full angle of angular motion
5 comprising:
 - a substrate having a first surface;
 - a first movable drive mass coupled to the substrate;
 - a second movable slave mass;
 - two sets of orthogonal drive electrodes coupled to the drive mass and defined in
10 a plane above the substrate;
 - two sets of orthogonal sense electrodes coupled to the slave mass and defined
in the same plane as the drive electrodes; and
 - a suspension coupling the drive mass to the slave mass, the suspension
restricting the range of motion of the drive mass to maintain movement of the drive
15 mass within a linear regime, while allowing amplification of movement of the slave mass
with respect to the drive mass.
2. The angle measuring gyroscope of claim 1 further comprising a control means for
maintaining oscillation of the slave mass without interfere with the measured precession
pattern of the slave mass, the control means being coupled to the sense and drive
20 electrodes.

3. The angle measuring gyroscope of claim 2 where the control means drives the slave mass at a constant amplitude at a first resonant frequency of the gyroscope.
4. The angle measuring gyroscope of claim 1 where the drive mass and slave mass are substantially decoupled from each other.
- 5 5. The angle measuring gyroscope of claim 3 where the first resonant frequency of the gyroscope corresponds to the first slave mass deflection peak.
6. The angle measuring gyroscope of claim 5 where the first resonant frequency is approximated as the first system eigenfrequency $\tilde{\omega}_1$.
7. The angle measuring gyroscope of claim 1 where the drive mass is an outer
10 drive mass and the slave mass is an inner slave mass as defined by the layout geometry of the gyroscope.
8. The angle measuring gyroscope of claim 1 where the drive mass is an inner drive mass and the slave mass is an outer slave mass as defined by the layout geometry of the gyroscope.

9. The angle measuring gyroscope of claim 1 where the drive mass is fabricated to lie in a plane and has at least one window defined therein, and where the drive electrodes are disposed in the at least one window and in the plane of the drive mass.

10. The angle measuring gyroscope of claim 1 where the slave mass is fabricated to
5 lie in a plane and has at least one window defined therein, and where the sense electrodes are disposed in the at least one window and in the plane of the slave mass.

11. The angle measuring gyroscope of claim 9 where the slave mass is fabricated to lie in a plane and has at least one window defined therein, and where the sense electrodes are disposed in the at least one window and in the plane of the slave mass.

10 12. The angle measuring gyroscope of claim 1 where the sense and drive electrodes each have a gap spacing between adjacent electrodes, and where the gap spacing for the sensing electrodes is greater than the gap spacing for the drive electrodes.

13. The angle measuring gyroscope of claim 2 where the control means generates an output position and velocity signal of the slave mass and feeds back the output
15 position and velocity signal to generate a control signal applied to the drive electrodes and hence to the drive mass to maintain motion of the slave mass at a constant energy state.

14. The angle measuring gyroscope of claim 13 where the control means maintains motion of the slave mass at a constant energy state by injecting additional energy into the drive mass at a first resonant frequency of the gyroscope, resulting in a dynamically amplified slave mass.

5 15. The angle measuring gyroscope of claim 2 where the control means feeds back the output position and velocity signal to generate a control signal applied to the drive electrodes without interfering with a Coriolis induced precession pattern of the slave mass.

16. A method of operating an angle measuring gyroscope which measures a full
10 angle of angular motion comprising:
driving a first movable drive mass with drive electrodes coupled to the drive mass and defined in a plane;
coupling the motion of the drive mass to a second movable slave mass through a suspension coupling between the drive mass and the slave mass, the suspension
15 restricting the range of motion of the drive mass to maintain movement of the drive mass within a linear regime, while allowing amplification of movement of the slave mass with respect to the drive mass; and
sensing motion of the slave mass with sense electrodes coupled to the slave mass and defined in the same plane as the drive electrodes.

17. The method of claim 16 further comprising maintaining oscillation of the slave mass by means of control of the sense and drive electrodes without interfering with the measured precession pattern of the slave mass.

18. The method of claim 17 where maintaining oscillation of the slave mass without
5 interfere with the measured precession pattern of the slave mass comprises driving the slave mass at a constant amplitude at a first resonant frequency of the gyroscope.

19. The method of claim 16 further comprising substantially decoupling the drive mass and slave mass from each other.

20. The method of claim 18 where driving the slave mass at a constant amplitude at
10 a first resonant frequency of the gyroscope comprises driving the slave mass at the first slave mass deflection peak.

21. The method of claim 20 where driving the slave mass at the first slave mass deflection peak comprises driving the slave mass at a first system eigenfrequency $\tilde{\omega}_1$.

22. The method of claim 16 where driving the drive mass comprises driving an outer
15 drive mass and where sensing the slave mass comprises sensing an inner slave mass as defined by the layout geometry of the gyroscope.

23. The method of claim 16 where driving the drive mass comprises driving an inner drive mass and sensing the slave mass comprises sensing an outer slave mass as defined by the layout geometry of the gyroscope.

24. The method of claim 16 where the drive mass is fabricated to lie in a plane and
5 has at least one window defined therein, and where driving the drive mass with the drive electrodes comprises driving drive electrodes in the plane of the drive mass, which drive electrodes are disposed in the at least one window.

25. The method of claim 16 where the slave mass is fabricated to lie in a plane and
has at least one window defined therein, and where sensing the slave mass with the
10 sense electrodes comprises sensing the slave made in the plane of the slave mass,
which slave electrodes are disposed in the at least one window.

26. The method of claim 24 where the slave mass is fabricated to lie in a plane and
has at least one window defined therein, and where sensing the slave mass with the
sense electrodes comprises sensing the slave made in the plane of the slave mass,
15 which slave electrodes are disposed in the at least one window.

27. The method of claim 16 where the sense and drive electrodes each have a gap spacing between adjacent electrodes, further comprising a gap spacing for the sensing electrodes is greater than the gap spacing for the drive electrodes.

28. The method of claim 17 further comprising generating an output position and velocity signal of the slave mass and feeding back the output position and velocity signal to generate a control signal which is applied to the drive electrodes and hence to the drive mass to maintain motion of the slave mass at a constant energy state.

5 29. The method of claim 28 further comprising maintaining the motion of the slave mass at a constant energy state by injecting additional energy into the drive mass at a first resonant frequency of the gyroscope, resulting in a dynamically amplified slave mass.

30. The method of claim 17 where feeding back the output position and velocity
10 signal generates a control signal applied to the drive electrodes without interfering with a Coriolis induced precession pattern of the slave mass.